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Research Article

Genetic variability and character association among biometrical traits in F_2 generation of some Rice crosses

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Abstract

Twenty five F_2 progenies derived from the crosses involving HYV ^{s} and quality rices were evaluated during kharif 2005. Eleven biometrical characters were studied for estimating phenotypic variance, genotypic variance, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), genetic advance, heritability (Broad sense), correlation coefficient and path coefficient among themselves. The analysis of variation revealed significant differences in the genotypes for all the characters studied. Per se performance of the progenies revealed that two F_2 progenies derived from the crosses IR-62 x Samba Mashuri and Kunti x Dudheswar were promising in respect of grain yield and some yield related traits. High GCV and PCV were observed for grain yield plant $^{-1}$, panicle number plant $^{-1}$ and panicle weight. High heritability was observed against all the characters studied excepting panicle weight, grain number panicle $^{-1}$ and grain breadth. Grain yield plant $^{-1}$showed maximum genetic advance as percentage of mean followed by panicle number plant $^{-1}$, plant height and panicle weight respectively. Grain yield plant $^{-1}$ possessed significant positive correlation with panicle number plant $^{-1}$, panicle weight and grain number panicle $^{-1}$ while it had significant negative correlation with plant height. Panicle number plant $^{-1}$ imparted maximum direct effect on grain yield followed by grain number panicle $^{-1}$, 1000 grain weight and panicle length in this regard.

Key words: Genetic variability, heritability, fertility percentage, component characters, direct effect

Introduction

Rice is the major cereal crop of South and South East Asia ninety percent of the world's rice is produced and consumed in this continent (Nanda, 2002). Most of the consumers, who depend on rice as their primary food, live in less developed countries. India occupies the first position in rice area and second position in production which almost tripled its production during the second half of the last century. Global demand for rice is projected to grow at least equal to population growth, thus requiring a 70% (765 mt) increase in supply of rice by the year 2025. In order to meet the future demand of rice, its production must be increased to match the rate of increase in population growth.

Knowledge on genetic variability is the basic requirement in any crop improvement programme. Therefore to improve the production of this important food crop a study of association of yield and its components are very much essential particularly in segregating population of rice. Any component of yield does not act independently; sometimes it reacts parallel to other component, sometimes control each other, acts in contradiction compensating for either an increase or decrease in other component (Matusuhima,1970). In this context, the present work has been undertaken to study the inter-relationship between yield and its components in the F_2 generation with a view to identify characters and their combinations which might be helpful to identify the selection criteria for higher yield in rice.

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Materials and Methods

The experimental material consisted of 25 F_2 progenies derived from twenty five different crosses developed at the Regional Research Station, New Alluvial Zone of Bidhan Chandra Krishi Viswavidyalaya, Sub-Centre Chakdah, Nadia,

during the wet season of 2005. Thirty days old seedlings were transplanted in five row plot of 5 m length in randomized block design replicated twice. Distances between hills and between rows were 20 cm and 15 cm respectively. Normal agronomic practices were followed throughout the crop growth period to obtain a good harvest. The observations were recorded on five randomly selected plants from each progeny row for the following eleven biometrical characters viz; plant height, panicle number plant $^{-1}$, panicle weight(g), panicle length(cm), grain number panicle $^{-1}$, fertility percentage, grain length(mm), grain breadth(mm), grain length breadth ratio (L:B),1000 grain weight (g) and grain yield plant $^{-1}$ (g). The genetic parameters were estimated based on the method suggested by Al Jibouri *et al.* (1958). The genotypic and phenotypic correlations were estimated following Johnson *et al.* (1955) and path analysis was carried out following Dewey and Lu (1959).

Result and Discussion

Analysis of variance revealed significant differences among the F_2 progenies for all the characters studied (Table-1). Wide range of variation observed for all the characters provides a large scope for selection on the basis of phenotypic value of the component characters. The estimates of phenotypic and genotypic variances were high for grain number panicle $^{-1}$, plant height, fertility percentage and grain yield plant^{-1}. grain breadth, grain L: B ratio, grain length and panicle weight showed very low genotypic and phenotypic variances. (Roy *et al*., 2001; Rao and Shrivastava, 1994 and Tripathi *et al*., 1999). A close proximity between GCV and PCV for all the characters except panicle weight, grain number plant $^{-1}$ and grain breadth indicates less influence of environment on such characters. Interestingly, all the above characters except L: B ratio had high heritability indicates the characters to be under more genetic control. But only plant height, panicle number plant $^{-1}$ and grain yield plant $^{-1}$ had high G A % of mean. Therefore, direct selection on the basis of phenotype for above three characters will be beneficial.

Further, the above statistical parameters indicate large scope for improvement of these characters in segregating generation. This observation corroborated the earlier finding of Choubey and Richharia (1993), Pushpa Kumari *et al.* (1999) and Nayak *et al.* (2002). A significant positive correlation of panicle number plant $^{-1}$, panicle weight and grain number panicle $^{-1}$ with yield plant $^{-1}$ could be noticed (Table-2). This finding is supported by earlier findings of Choubey and Singh (1994). Path coefficient analysis (Table-3) was based on the correlation coefficient using grain yield as the dependent factor (effect) and other quantitative characters viz, plant height, panicle number plant $^{-1}$, panicle weight, panicle length, grain number panicle $^{-1}$, fertility percentage, grain length, grain L:B ratio and 1000 grain weight as independent characters (causes). Correlation coefficient of each independent character was partitioned into direct and indirect effects towards grain yield. All direct effect towards grain yield per plant was positive except grain length and grain breadth.

Panicle number plant $^{-1}$ imparted the maximum direct effect on grain yield followed by grain number panicle$^{-1.}$ Both these characters had significantly positive correlation with yield. Thousand grain weight, panicle length, fertility percentage in spite of showing substantial direct effect could not produce significant positive correlation. This might be due to high negative indirect effect. The present findings are in conformity with the reports of Reuben and Kisanga (1989), Padmavathi *et al.* (1996), Choudhary and Das (1997, 1998), Sarkar *et al.* (2005).

Panicle number that contributed highest amount of positive direct effect towards yield also showed considerable amount of positive indirect effect via grain number panicle $^{-1}$. Further, grain number panicle $^{-1}$ also contributed a considerably high amount of positive indirect effect via panicle number plant $^{-1}$. Therefore, these two characters may be considered as prime yield components in rice. Highly significant positive correlation of panicle weight with grain yield was mainly due to high positive indirect effect via grain number panicle $^{-1}$, fertility percentage and panicle number plant $^{-1}$.Therefore, to utilize such positive association of panicle weight in yield improvement, these casual factors should also be simultaneously considered during selection in rice. It may be mentioned that panicle number plant $^{-1}$exhibited high heritability as well as high GA (as % of mean).

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Table1: Genetic variability parameters for different characters in F_2 generation of rice.

Sl. No.	Characters	Mean	Range	SE (df)	C.V	G.C.V	P.C.V	h^2	G.A	G.A as a % of mean
1	Plant height (cm)	123.92	85.50 - 167.50	5.20	25.74	17.95	18.44	0.94	44.63	36.02
2	Panicle number plant $^{-1}$	9.86	4.10 - 17.80	1.81	45.93	29.72	34.96	0.72	5.13	52.06
3	Panicle weight (g)	2.09	1.14 - 3.02	0.38	34.26	20.39	27.42	0.55	0.65	31.22
4	Panicle length (cm)	23.18	19.50 - 26.50	0.91	12.16	8.13	9.04	0.80	3.49	15.08
5	Grain number panicle $^{-1}$	130.72	84.00 -186.50	24.64	23.41	12.22	19.96	0.37	20.13	15.40
6	Fertility %	61.30	50.25 -73.59	3.57	19.95	8.96	10.69	0.70	9.48	15.48
7	Grain length(mm)	8.57	7.10 - 9.90	0.24	9.55	6.45	7.03	0.83	1.04	12.17
8	Grain breadth (mm)	2.17	2.40 - 2.90	0.15	8.16	4.20	7.02	0.35	0.14	5.19
9	L:B Ratio	3.17	2.49 - 3.91	0.22	15.64	9.86	12.12	0.66	0.52	16.51
10	1000 grain weight (g)	22.55	17.30 - 27.40	1.21	14.37	9.42	10.85	0.75	3.80	16.87
11	Grain yield plant $^{-1}$ (g)	15.00	4.42 - 25.41	2.98	50.19	32.56	38.17	0.72	8.58	57.23

Table2: Genotypic (G) and Phenotypic (P) correlations among grain yield and yield components in F_2 progenies of Rice.

Characters		Panicle number Plant $^{-1}$	Panicle Weight (g)	Panicle length (cm)	Grain number Panicle $^{-1}$	Fertility %	Grain length (mm)	Grain breadth (mm)	L:B Ratio	1000 grain Weight (g)	Grain Yield Plant $^{-1}$ (g)
Plant height (cm)	G	-0.378*	-0.372*	-0.066	-0.361*	-0.118	-0.327	0.399*	-0.350*	-0.301	-0.532**
	P	-0.305	-0.295	-0.072	-0.231	-0.076	-0.283	0.201	-0.260	-0.281	-0.450*
Panicle number Plant $^{-1}$	G		0.193	0.085	0.633**	-0.371*	0.053	-0.393*	0.196	-0.105	0.820**
	P		0.206	0.016	0.367*	-0.179	0.035	-0.185	0.118	-0.137	0.764**
Panicle Weight (g)	G			0.002	0.696**	0.724**	-0.229	0.255	-0.298	0.029	0.619**
	P			0.108	0.634**	0.549**	-0.123	0.071	-0.150	0.017	0.647**
Panicle length (cm)	G				-0.007	-0.227	-0.016	0.500**	-0.241	0.142	0.240
	P				0.139	-0.155	0.004	0.247	-0.155	0.039	0.288
Grain number Panicle $^{-1}$	G					0.527**	-0.633**	0.090	-0.498**	-0.480**	0.835**
	P					0.206	-0.361*	0.045	-0.250	-0.257	0.652**
Fertility %	G						-0.317	0.190	-0.295	-0.333	0.095
	P						-0.219	0.024	-0.160	-0.298	0.183
Grain length (mm)	G							-0.587**	0.904**	0.602**	-0.160
	P							-0.546**	0.873**	0.486**	-0.093
Grain breadth (mm)	G								-0.885**	0.145	-0.015
	P								-0.879**	0.121	-0.68
L:B Ratio	G									0.303	-0.128
	P									0.196	-0.043
1000grain Weight (g)	G										-0.055
	P										-0.117

*Significant at 5% level **Significant at 1%

Table3: Direct and indirect effects of yield components on grain yield in F_2 generation of rice.

Characters	Plant Height	Panicle number plant $^{-1}$	Panicle Weight	Panicle Length	Grain number Panicle $^{-1}$	Fertility %	Grain Length	Grain breadth	L:B ratio	1000 Grain Weight	Yield Correlation
Plant height	**0.055**	-0.218	-0.024	-0.019	-0.166	-0.024	0.056	-0.046	-0.035	-0.108	-0.532**
Panicle number Plant $^{-1}$	-0.021	**0.577**	0.012	0.017	0.292	-0.076	-0.009	0.045	0.020	-0.037	0.820**
Panicle weight	-0.020	0.111	**0.066**	0.000	0.321	0.150	0.039	-0.029	-0.030	0.010	0.619**
Panicle length	-0.003	0.033	0.000	**0.291**	-0.003	-0.047	0.002	-0.058	-0.024	0.051	0.242
Grain number panicle $^{-1}$	-0.020	0.365	0.046	-0.001	**0.461**	0.109	0.108	-0.010	-0.051	-0.172	0.835**
Fertility %	-0.006	-0.214	0.047	-0.066	0.243	**0.207**	0.054	-0.022	-0.030	-0.119	0.095
Grain length	-0.018	0.030	-0.015	-0.004	-0.292	-0.065	**-0.171**	0.068	0.092	0.216	-0.160
Grain breadth	0.022	-0.226	0.016	0.145	0.041	0.039	0.100	**-0.116**	-0.090	0.052	-0.015
L:B ratio	-0.019	0.113	-0.019	-0.070	-0.230	-0.061	-0.155	0.102	**0.102**	0.109	-0.128
1000 grain Weight	-0.016	-0.016	0.001	0.041	-0.221	-0.069	-0.103	-0.016	0.031	**0.359**	-0.055

*Significant at 5% level **Significant at 1% Residual effect-0.2066357